NOAA FISHERIES
Alaska Fisheries Science Center

Science behind Sustainable Seafood Module
Overview and Lesson 1

Overview of SBSS Module

This module introduces 6 lessons that help teachers and students understand the science behind the responsibly managed fisheries of the U.S. Walleye pollock is our focus species, but during some of the modules the students get to explore other animals in the Bering Sea ecosystem and other marine ecosystems in Alaska. All of the lessons were modified from activities that were created by scientists at the NOAA Fisheries Alaska Fisheries Science Center. Lesson 6 is a cumulative lesson using a role playing activity. If you plan on using the entire curriculum, make sure you designate the different roles beginning at lesson 1 or 2.

Module design

The module lessons are designed to use as a whole or as standalone lessons to plug into pre-existing curricula. The lessons attempt to utilize the BSCS 5E instructional model that helps students master and integrate the concepts being explored.

Lessons

1. **Fishing for the Future** - Alaska Sea Grant Rivers and Streams Curriculum
   Introduce concepts of resource utilization and need for resource management.
2. **How many fish are there?** – How do scientists estimate population size of fish?
3. **Age matters!** – How do certain biological parameters of a fish influence population health?
4. **Survival in a Dangerous Environment** – How can environmental factors influence population growth?
5. **Solving the Ecosystem Puzzle** – How do predator/prey interactions influence population growth?
6. **Responsible Management** – What does it take to ensure sustainably harvested seafood?

Skill building:
Basic fish physiology - Use of dichotomous keys, skill in observational subtleties
Data management
Population biology - what drives a population
Computer skills
Math skills - especially statistics
GIS
Critical Thinking

Key Subjects/Standards

National	**Science**: NS.9-12.1 Science as Inquiry. NS 9-12.3 Life Science: Interdependence of organisms, Behavior of organisms. NS 9-12.6 Personal and Social Perspective: Population growth, Natural resources, environmental quality. **Math:** NM-NUM. 9-12.3 Number and Operations: compute fluently and make reasonable estimates. NM-PROB.CONN.PK -12.3 Connections: recognize and apply mathematics in contexts outside of mathematics.

	Economics: NSS-EC.9-12.1 Scarcity. NSS-EC.9-12.4 Role of incentives. **Social Sciences:** NSS-G.K-12.2 Places and Regions. NSS-G.K-12.3 Physical Systems.
Ocean Literacy	Essential principle and fundamental concepts ES 5. The ocean supports a great diversity of life and ecosystems (fc: a, b, c, d, e, f). ES 6. The ocean and humans are inextricably interconnected (fc: b, c, e, g).

Background

What's the big deal about seafood?

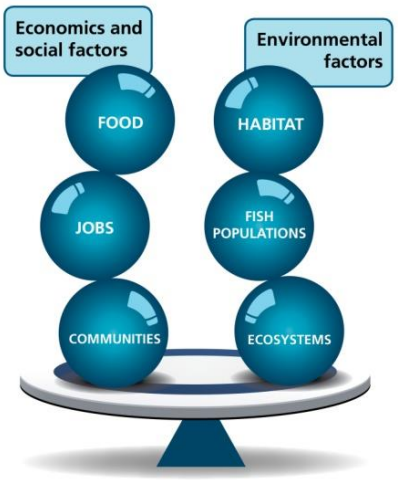
Seafood is good for your health. The U.S. is the third largest consumer of seafood in the world. Americans consume 15 pounds of seafood per person per year, which is good news because seafood is a healthy source of protein, vitamins and minerals. That's why the USDA recommends eating it twice a week.

It's healthy for the economy. Commercial, sport and subsistence fisheries contribute significantly to the local and national economy. In 2011 seafood harvested by U.S. fishermen at ports in the 50 states were valued at $5.3 billion. The U.S. is the largest importer of seafood in the world, valued at over $16.6 billion, and the fifth largest exporter of seafood in the world, valued at over $5.4 billion. The seafood industry provides employment opportunities for many people, too. Do you know anyone who has a job because of seafood?

Sustainable Seafood: It's all about balance

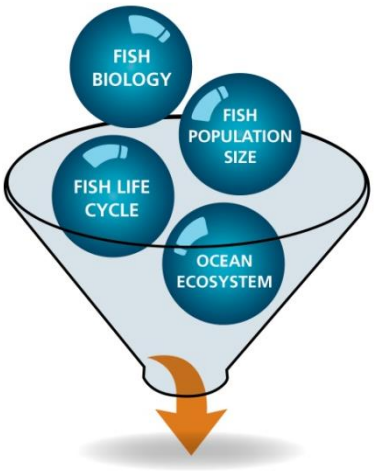
Conserving our natural resources, whether on land or at sea, is something we are all concerned about. For this reason, laws were created that ensure these resources are available for future generations. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) is the principle law governing U.S. marine fisheries. The MSA mandates that NOAA Fisheries limit the amount of fish harvested to prevent or end overfishing.

Limiting the amount of fish harvested may sound easy but it is a challenging balancing act. Factors like the need for jobs and food are considered as well as ensuring healthy fish populations and ecosystems. Fortunately, there is a process that brings in a team of people such as scientists, fishermen, resource managers, tribes and citizens to work together in what are called Fishery Management Councils. At Council meetings scientists give their recommendation for a harvest limit and then others can discuss whether that number should be lowered based on economic, social or environmental factors. If any one of these things is out of balance, then a fishery could be considered unsustainable.



What does science have to do with seafood?

The goal of fishery science is to determine the amount of fish to harvest that does little to no harm to the environment and leaves enough fish in the water for the population to renew itself. This is no easy task. It will take many different types of scientists to conduct the research to have the scientific knowledge necessary to responsibly manage a fishery. A mathematician will work on estimating fish population size; a biologist will find out things like how old a fish gets, or how many eggs survive to adulthood during a fish's life cycle and a group of scientists including oceanographers, mathematicians and biologists work together to determine what influences an ecosystem. The lessons in this module were developed to help teach the science behind sustainable seafood.



Curriculum preparations

If you intend to go through the entire module, read Lesson 6 first.

At lesson one or two, depending on which one you start with, have the students select the group (or choose randomly) they will be representing at the culminating activity - a Fishery Management Council meeting.

From lesson 6: Break classroom into 4 groups. Each gets different reading, different data sets, samples, maps or problems, different issues for discussion, different field sites, and so on throughout the module. See factsheets at end of this lesson, they help explain the following groups and what their roles and position are.

1. Industry representatives
2. Council members
3. Concerned Citizens
4. Scientists

Lesson One

Overview

Lesson one is to introduce students to the concepts of carrying capacity, "The Tragedy of the Commons," and natural resource regulation. Have students go through a mock fishing activity as described in the Alaska Seas and Rivers Curriculum – Fishing for the Future.

Provide students an overview of the theory of the tragedy of the commons, you can use this website for help in synthesizing the general messages, here is another website that simplifies this even further. If you really want a book that helps simplify this even further check out Common Grounds by Molly Bang. For more advanced students, or as a class, read both Tragedy of the Commons (really challenging read) and the OpEd piece called the

"Non Tragedy of the Commons" (more accessible) which highlights the work of Nobel Laureate in Economics, Elinor Ostrom.

Exploration:

After going over the theory of the Tragedy of the Commons, have the students self-select into two groups: those that agree and those that disagree with the theory. Use the questions below to being a discussion/debate about different shared resources.

1. First make a list of various resources that are shared by a large group of people.
2. Determine which ones may be headed for a tragic ending.
3. Which ones may not be.
4. Discuss the difference between those shared resources that may be headed for a tragic ending and those that are not.
5. What causes a tragic situation?
6. What has to happen to avoid tragedies of commonly used resources?
7. How does resource management and the government fit into this situation?
8. What challenges happen when the resource is not contained within one government's jurisdiction?

Engagement

Have the students discuss how the different groups they represent (Industry, Scientists, Concerned Citizen and Council) will view regulation of natural resources or resources that are in the public domain?

Extra Credit

Have the students check out the Port Orford, OR, ocean resources team and see how the community is helping conduct their own fisheries management. http://www.oceanresourceteam.org/

Description of Different Groups from Lesson 6

Role: Concerned Citizen

Position: Respect uncertainty in the science, reduce the TAC by x percent.

Who are you?

You are a group of concerned citizens representing various non-profit/non-governmental organizations (NGO), you may also represent an Alaska Native group.

Why are you concerned?

1. Fishing may harm bottom habitat
2. Fish populations may decrease due to climate change
3. Marine Mammal populations are decreasing and need more pollock to eat.
4. Alaska Native subsistence foods may be negatively impacted by fishing effort.

For your presentation:

- Introduce your group – come up with a name and what your mission is.
- Statement of your concern – choose one from above list.
- Present information that supports your concern.
- Conclude with how much your group proposes to lower the TAC (in percent).

Roles for group

- Presenter(s) – one or two can present
- Researcher(s)
- Analysis -all

Resources

Essential Fish Habitat in Alaska: http://alaskafisheries.noaa.gov/habitat/efh.htm

Climate impacts to Alaska: http://www.epa.gov/climatechange/impacts-adaptation/alaska.html

Possible climate impacts on Alaska fisheries: https://seagrant.uaf.edu/map/climate/

Which marine mammals eat pollock? http://www.afsc.noaa.gov/nmml/education/marinemammals.php

Subsistence harvesting in Alaska: http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.main

Role: Fishery Scientists

Position: We analyzed the data and came up with a TAC. It was decreased by 5% because of uncertainty in certain ecosystem parameters.

Who are you? and What do your data say?

1. Fish biologist – what is age distribution of population from fishery data and from survey data
2. Fish oceanographer – where are baby Pollock and what are the oceanographic conditions? what is the bottom temperature for 2011? What happens to Pollock population when the water is cold?
3. Observer – How much fish did fishery catch? What does the trend look like? Bycatch data?
4. Ecologist – What other ecosystem parameters should be considered?

For your presentation:

- Introduce your group – What are your jobs?
- Statement of your findings
- Present information that supports your findings.
- Population estimation
- Calculation of overfishing level (OFL) and total allowable catch (TAC)
- What are key environmental indicators saying?
- Fishery catch data compared to total population size.
- Conclude with your proposed TAC level and why it may be less than what was calculated.

Roles for group:

Each group member is one type of scientist. If you do not have enough people just omit one of the scientists, but you still have to present their data. Take turns presenting your findings to the Council, so everyone gets a chance to present.

Resources:

Most recent Pollock assessment - http://www.afsc.noaa.gov/refm/stocks/assessments.htm

Ecosystem Report Card: http://access.afsc.noaa.gov/reem/ecoweb/

Fishery Data: http://www.afsc.noaa.gov/FMA/datamap/obsmap.html

Age and growth map: http://www.afsc.noaa.gov/REFM/Age/dynamic_maps/agemap.html

Role: Industry stakeholders

Position: Respect the science give us the full scientist recommended TAC, don't reduce further.

Who are you?

1. Large Fishing Company: Trident Seafood Company, American Seafood,
2. Small Boat Fisherman,
3. Restaurant owners or Chef
4. Shipbuilder, Bank loan officer, or hotel owner.

Research the history in how industry supports sustainable seafood

Presentation:

- Introduce your position
- Present history of industry in seafood industry
- Present economic data from Alaska seafood
- Conclude that industry supports science and that the TAC should not be reduced any further.

Role for Groups:

- Researcher(s)
- Compiler of information
- Create presentation
- Presenter(s)

Resources:

- Chef's Collaborative - http://chefscollaborative.org/
- Alaska Seafood Marketing Institute - http://www.alaskaseafood.org/
- Commercial Fisheries of the U.S.- economic data - http://www.st.nmfs.noaa.gov/st1/publications.html

Role: Fishery Management Council

Positon: Council members do not have a position. They must objectively review all the information presented to them and make decisions based on the National Standards of the Magnuson-Stevens Fishery Conservation and Management Act.

Who are you?
Council members
The ideal Council appointee candidate is knowledgeable in fishery conservation management and the commercial or recreational harvest of fishery resources through occupational experience, scientific expertise, or related training.
http://www.fakr.noaa.gov/npfmc/membership/council-members.html

Duties:
All Council members must take the training by going over the Intro to Council powerpoint presentation.
Robert's Rules of order – see handout

Council Scorecard

Using the National Standards scorecard below, provide a check for each national standard that each group satisfies through their presentation.

National Standards		Scientists	Citizens	Industry
1	Achieve Optimum Yield and prevent overfishing			
2	Best available scientific information			
3	Manage stocks as a unit			
4	Allocations fair and equitable, promote conservation, and prevent excessive shares			
5	Consider efficiency in utilization; not have economic allocation as sole purpose			
6	Allow for variations and contingencies			
7	Minimize costs, avoid duplication			
8	Consider fishing communities to provide for their sustained participation and to minimize adverse economic impacts			
9	Minimize bycatch, bycatch mortality			
10	Promote safety of human life at sea			
	Total number of checks			

Based on the number of checks, lower the TAC using the table below: # of checks >1, lower by 2%; # checks >5, lower by 5%; #of checks >7, lower by 10%.

Presenter	TAC	Decrease TAC (%)	Total
Scientists		NA	
Concerned Citizens			
Industry Stakeholders			

For more information and questions:

Contact the Alaska Fisheries Science Center Education Team
Website: http://www.afsc.noaa.gov/education/
Email: afsc.outreach@noaa.gov